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I, LEANNE MYNOTT, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. PQ1956 for a patent by PETER RAFFAELE and MICHAEL RAFFAELE filed on 30 July 1999.



WITNESS my hand this
Eleventh day of April 2000

LEANNE MYNOTT
TEAM LEADER EXAMINATION
SUPPORT AND SALES


Improvements to reciprocating devices

This invention relates to scotch yoke engines. More particularly to our earlier applications relating to same. We disclosed in our earlier applications certain improvements to scotch yoke type engines and one of these was the re-configuration of the yoke assembly so that the piston pairs are decoupled from one and other and the at least two horizontal slide surfaces of the yoke assembly are on one side of the big end. We incorporate all those applications and our improved crank disc and scotch yoke disclosures in this application. Figure 1 depicts a piston 32, with a horizontal sliding coupling means 30 according to our earlier disclosures numbering format, the slot can be unitary with the piston or can be attached to the piston or part/s of the slot can be unitary with the piston and part/s can be attached in any case in this depiction it is shown in its simplest form, a simple machined slot!

Now, breaking from the numbering format of our earlier applications, and addressing fig 1 again one will notice that the piston 32 further comprises piston alignment tabs 10a and 10b these tabs may be unitary with the piston or may be attached to the piston, these tabs have surfaces that are slidably engaged in slide-ways that are substantially fixed to the engine block or other useful purchase point or part.

The idea is to increase the axial stability of the piston as it reciprocates along its axis in the cylinder, this may be necessary because the pistons usually need large clearances in their fit within the cylinder and as a consequence the orbiting slide block may suffer free movement, we have suggested various remedies for this in our earlier applications e.g the addition of vertical slideways attached to the conrod

or piston or parts thereof. We now would like to elaborate on our earlier disclosures. The reciprocating vertical slide surfaces of the piston can be located inboard of its respective cylinders circumference! This is a very compact configuration. A slightly less compact arrangement would see the vertically reciprocating surfaces engaging with their respective slideways outboard of the cylinder circumference or alternatively the surfaces may be slidingly engaged partly within and on and without the respective cylinder's circumference! The reciprocating slide surfaces attached to or a portion of the piston or the conrod may be disposed symmetrically of the piston axis or non symmetrically, also the said surfaces may be on one side of the piston and not any other or an uneven amount of slide surfaces may be more beneficial. When considering figures 1, 1a, 1b, 1c, 1d, 1f, slot 30 is a horizontal slide and 10a and 10b are vertical slide you will note that the tabs 10a, b are part of the piston ie cast or forged with the piston proper, 10a, b are to guide the piston up and down in the bore, they do this by engaging with slideways v and m. V and m are attached to the engine block or other suitably solid mount site or locale. J is the circumference of the piston and Q is the line of symmetry of the piston, this line is parallel to the axis of the crank. Fig 1 thru 1f have tabs 10a and 10b these tabs with their attendant surfaces x and y do not extend outwards of the piston circumference j. The beauty of this layout is that the surfaces x and y are very close together which means there is very little material between these surfaces to expand as the engine heats up. Figures 3 thru 44 depict various other preferred embodiments of the invention like numbers mean the same as they do in figures 1 etc. The reader will notice that the tabs in these drawings may have different mount sites in relation to the line of symmetry q, and that some of



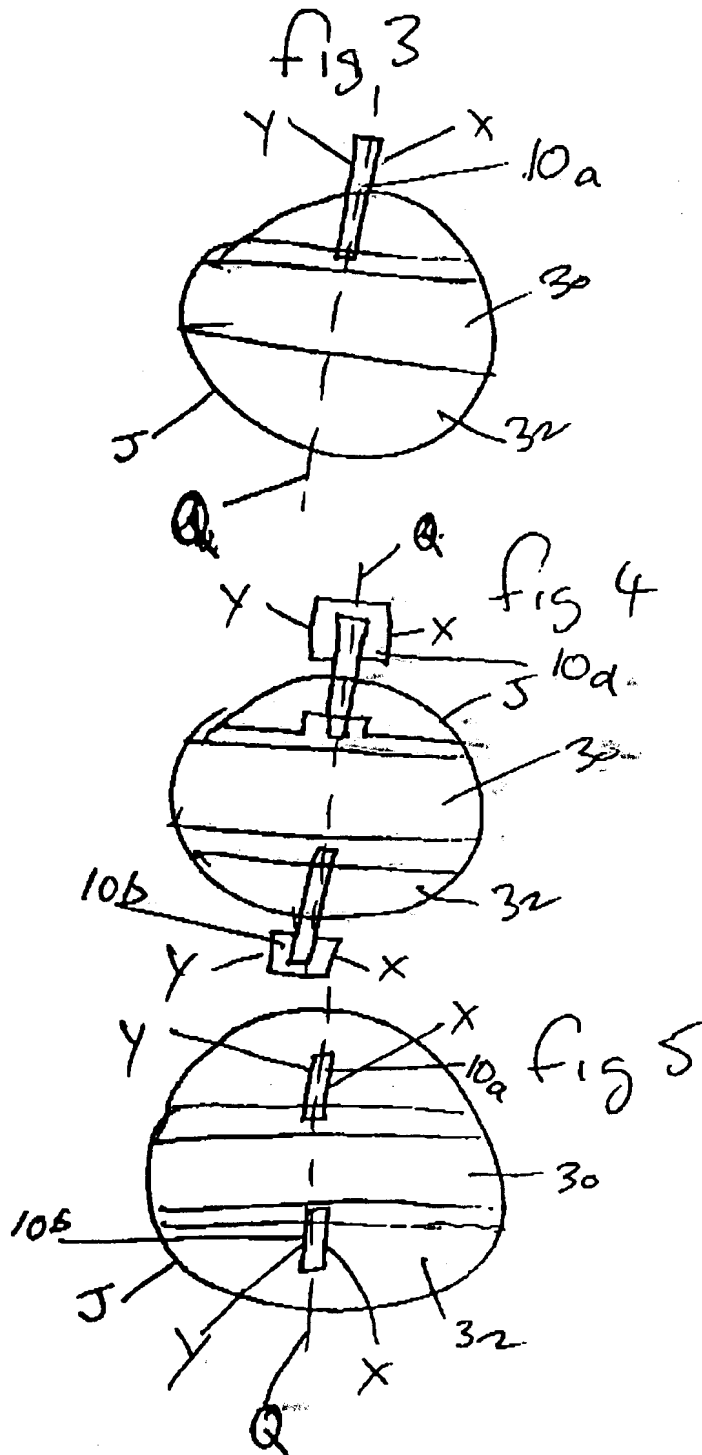
the tabs extend outward of the piston circumference j and that not all of the tabs have simple flat surfaces but have more complex shapes.

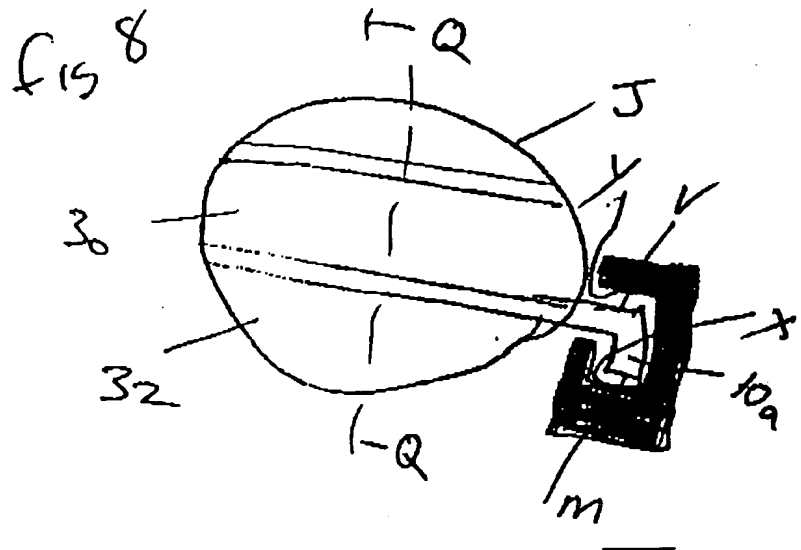
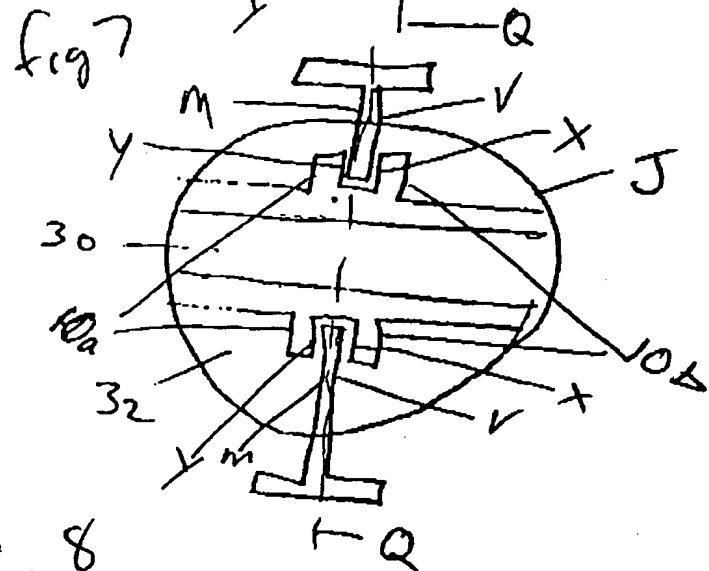
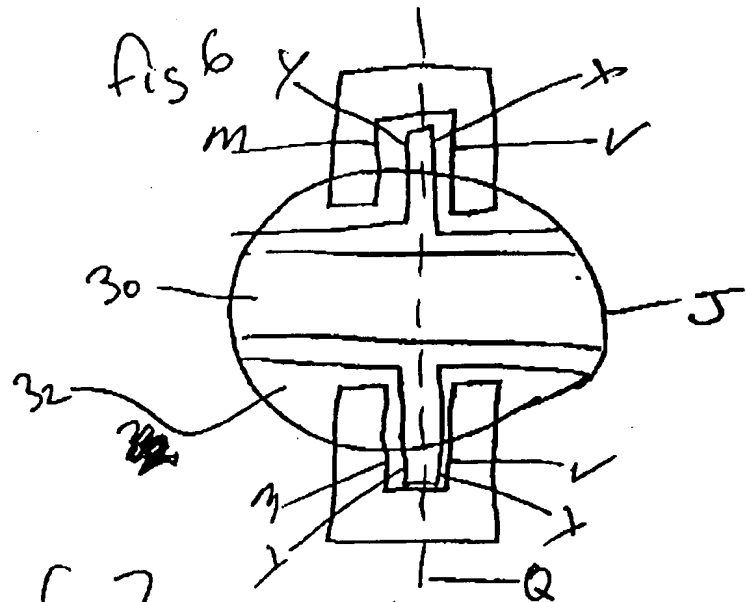
Also most of the drawings don't show the slideways v and m , however the slideways v and m are adapted to fit the shape whatever it is that the tabs surfaces require to enjoy correct sliding engagement.

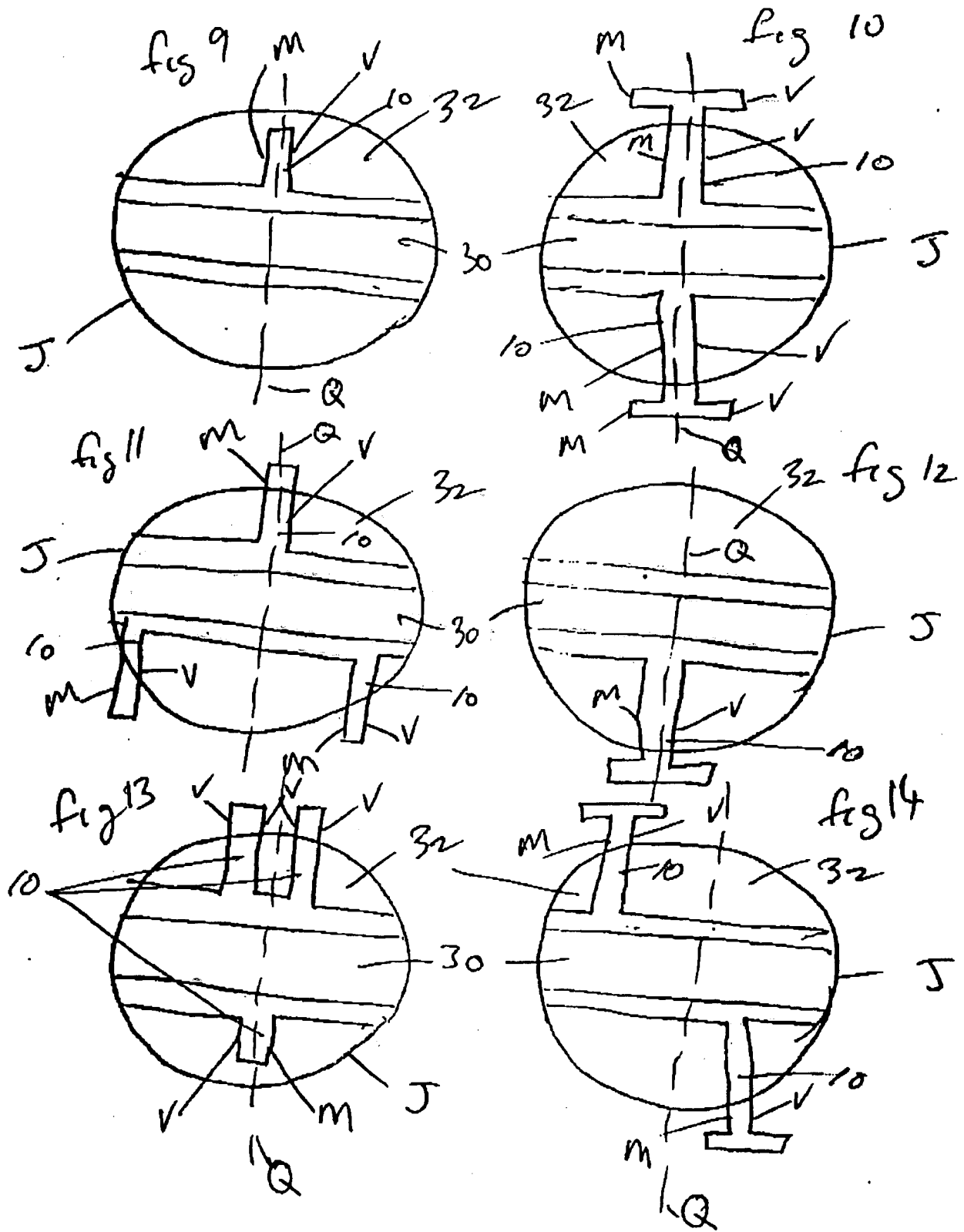
Also this engagement with the said guide will remain substantially parallel given that either the block guide may be facilitated with an pivot axis joint or the piston guide may be separately facilitated with an pivot axis joint in as much as this affords the mechanism a degree of freedom to normalise its location and presentation for load carrying. . This ability, as another embodiment of this invention, to self align and to normalise by design intent, affords this mechanism a non regressive approach to the problem of apparently parallel slideways being microangularly non-parallel. That prior non-parallelism is a function of the limit of others' designs and inherent phasing of the hydrodynamic lubrication of a parallel reciprocating tribology. In the machines operating environment, given the thermal gradients and the aggressive lubrication restrictions, wherein large clearances between the piston and cylinder bore are maintained whilst cold, a pivoting member of the coupling alleviates the mutually antagonistic presentation of a not so cylindristic piston to bore circumfurenciality when eg the machine is outside the normal operating temperature range and also whilst and during the more preferred operating parameters, which wayward motion and angularity is transmitted to the sliding parallel joint but, in this invention that misalignment is provided a means of alignment by the said axis pivot joint outlined above.

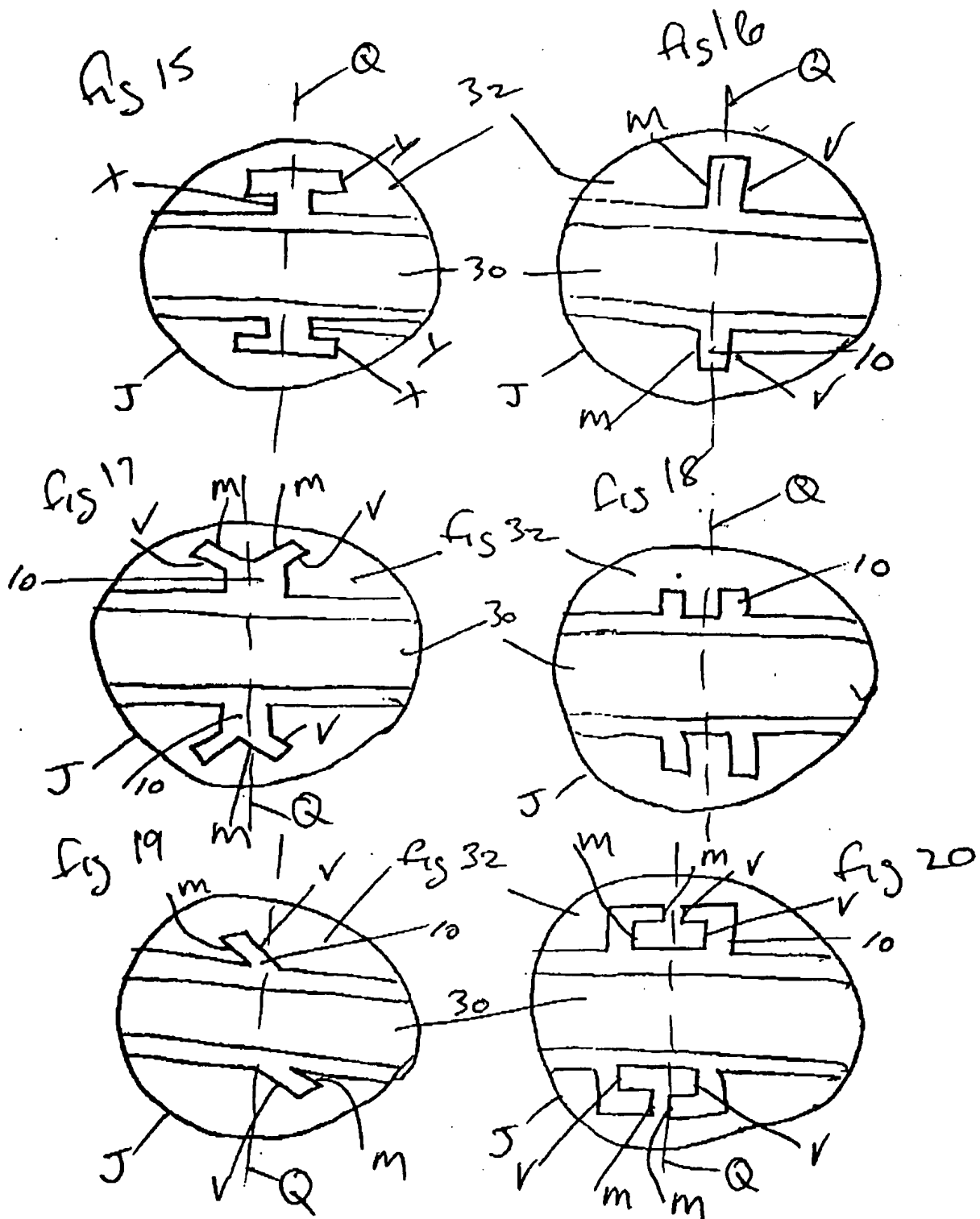
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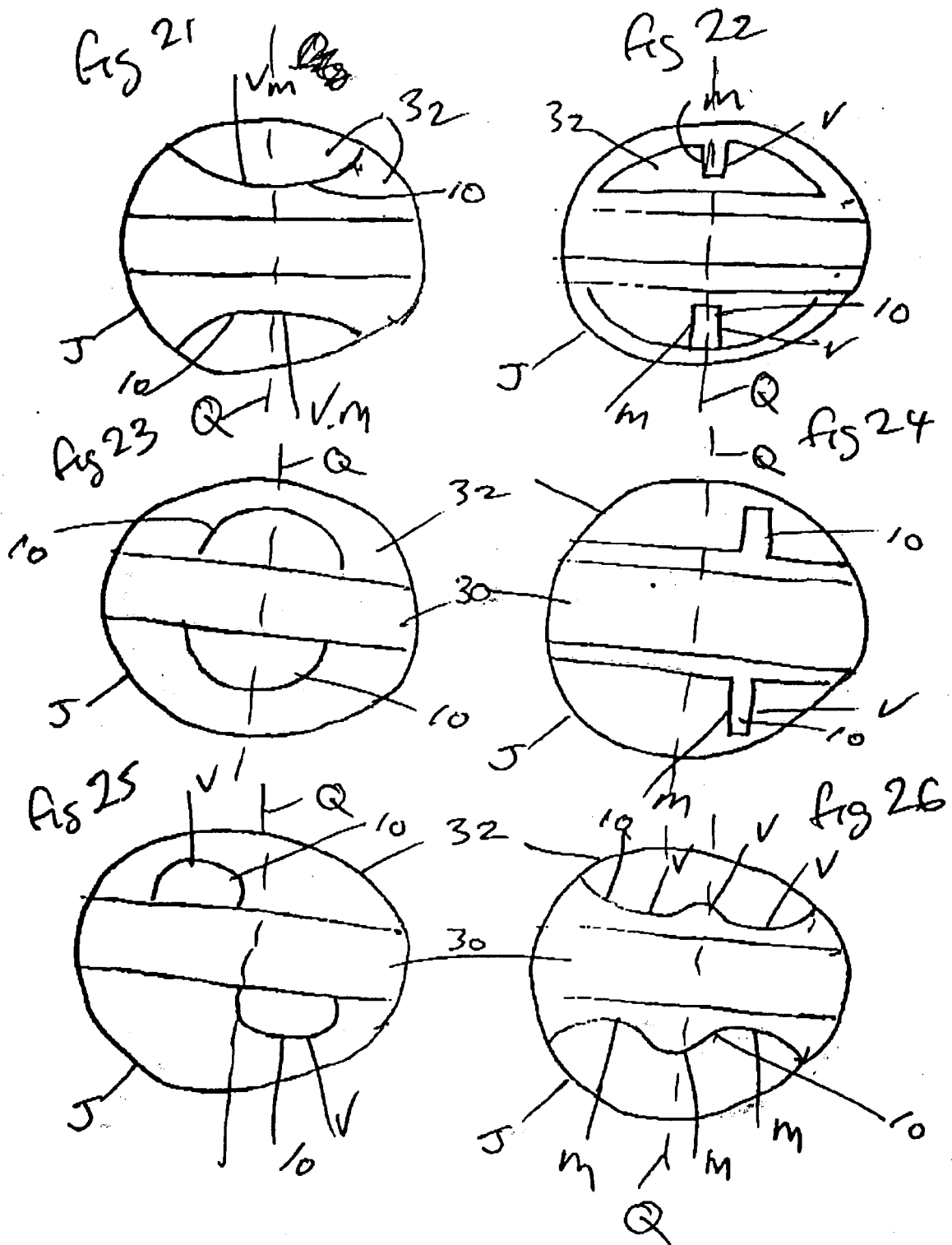
Figure 46 depicts a piston 42 mounted on a conrod 66 by means of shaft 217 which extends through the crown of the piston to conrod where it is engaged with a screw thread and the piston. Shaft 217 is received in the piston by bearing blocks 40 and located between the piston base portion there is located resilient member 15. This piston conrod assembly as in all figures through to 80 are variable compression ratio pistons and like numbers mean the same thing. The resilient member or members may be a spring elastic material a displaceable pneumatic or hydraulic member. The piston has a total maximum length from top of crown to big end axis this is facilitated by physical mechanical stop means. Also other configurations may be employed wherein multiple resilient or mechanical stops are employed

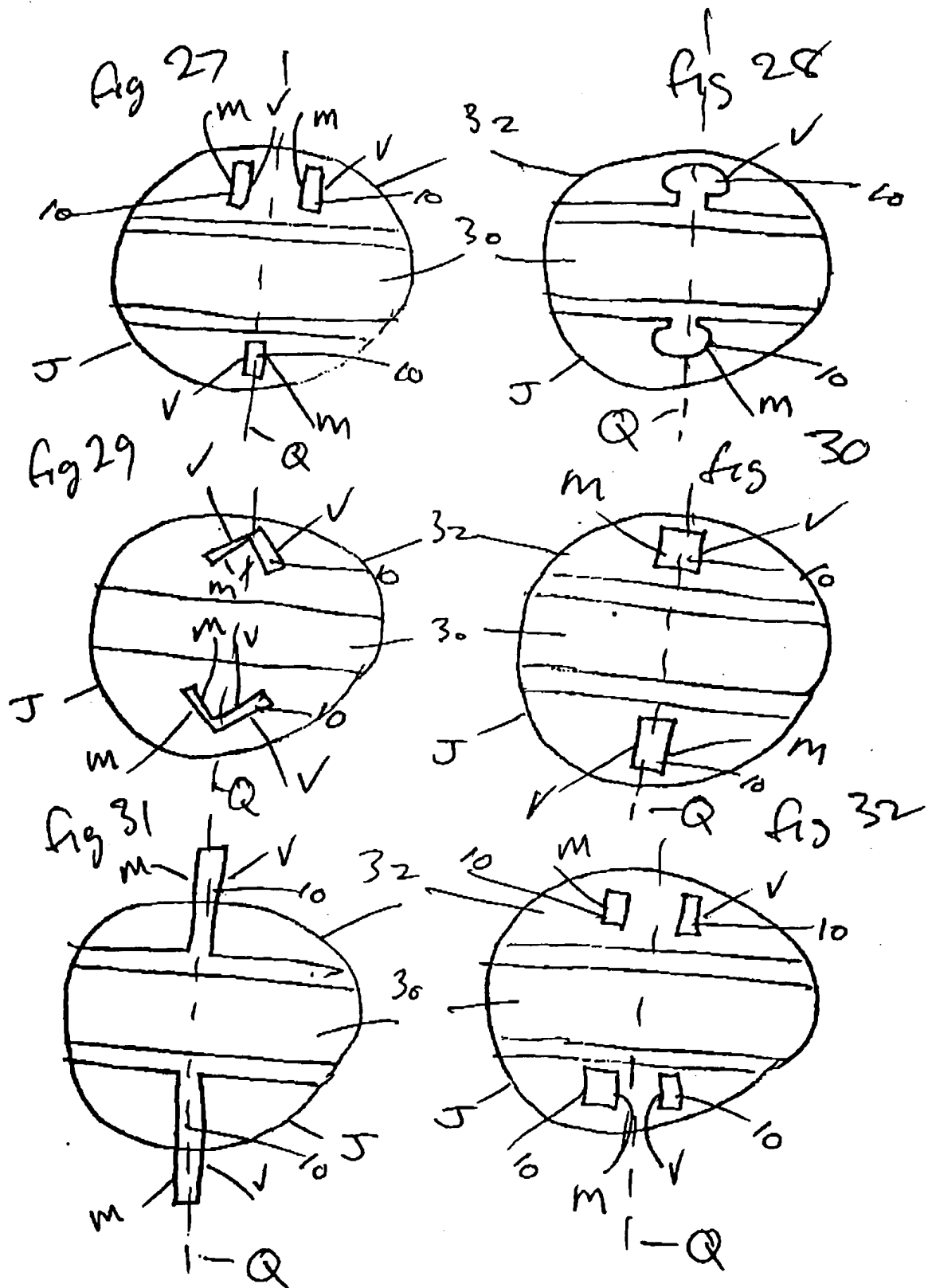


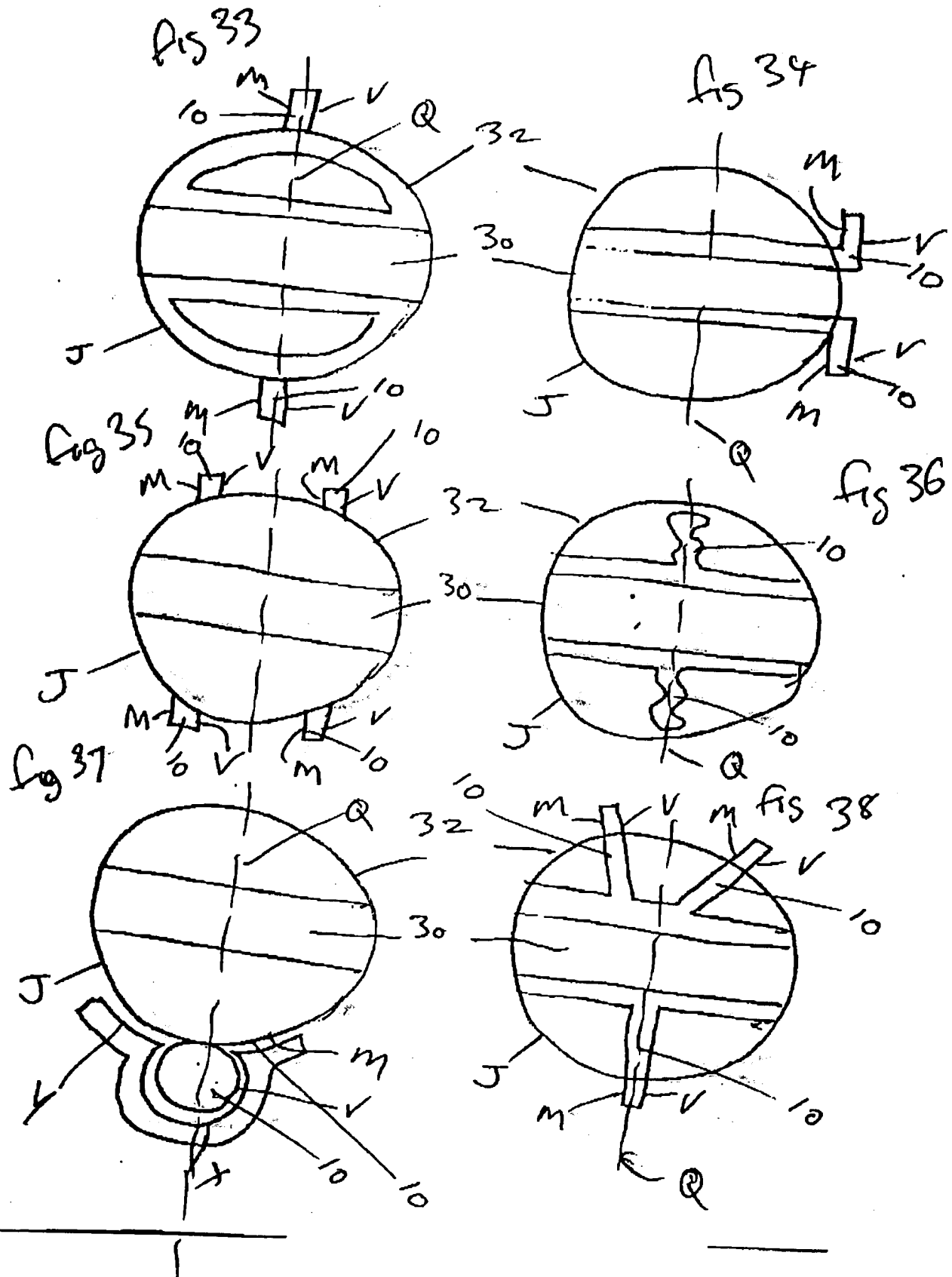


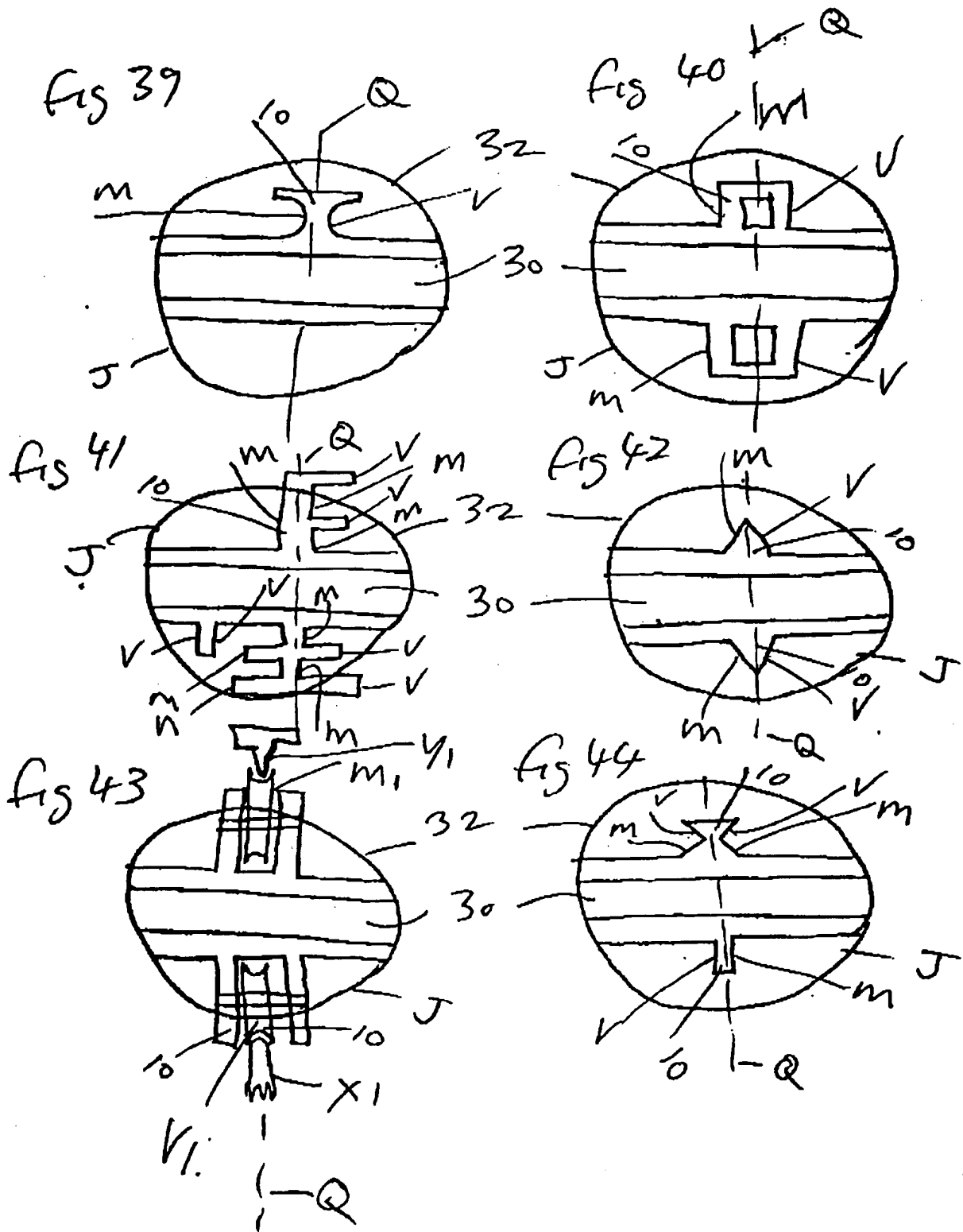


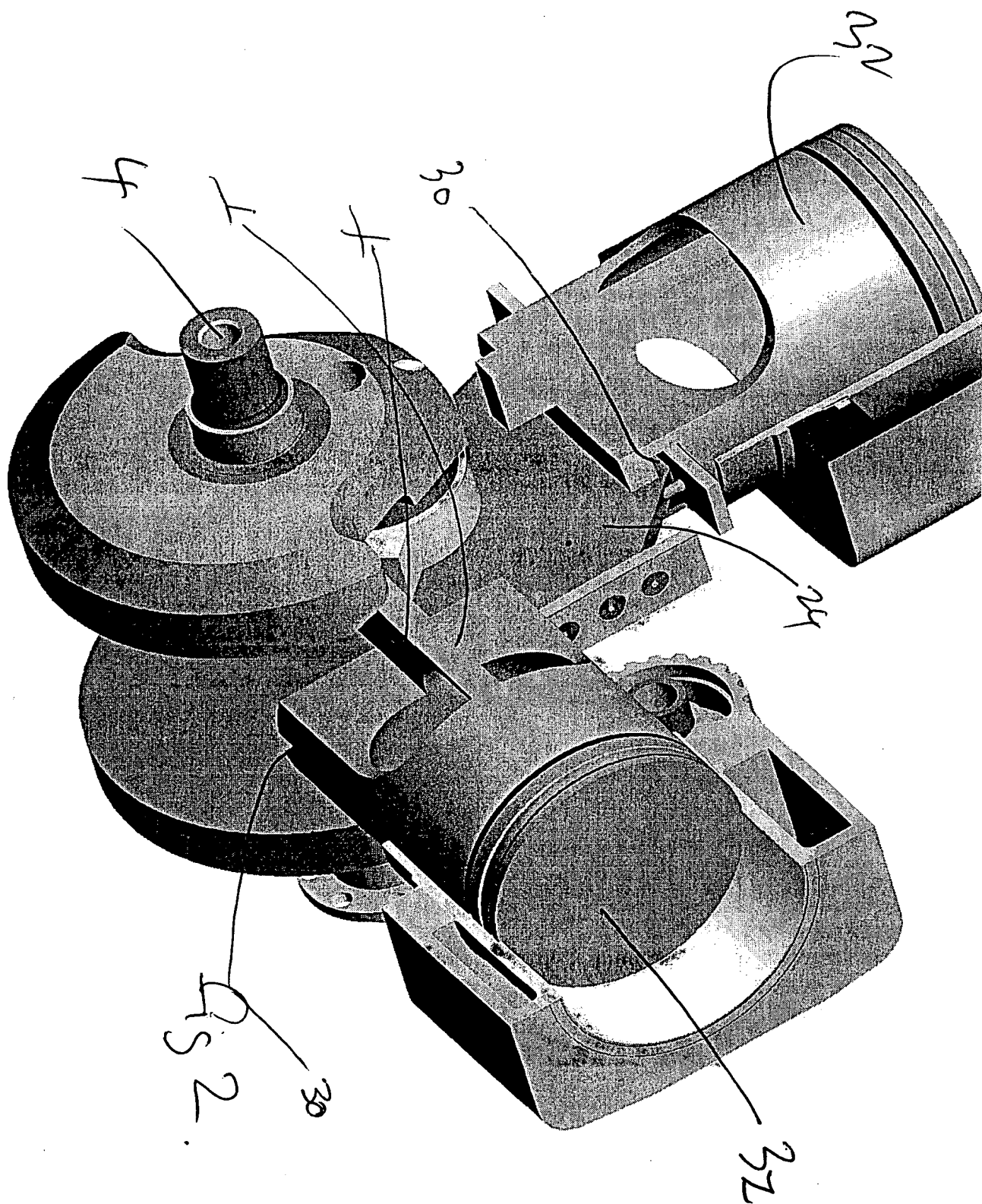


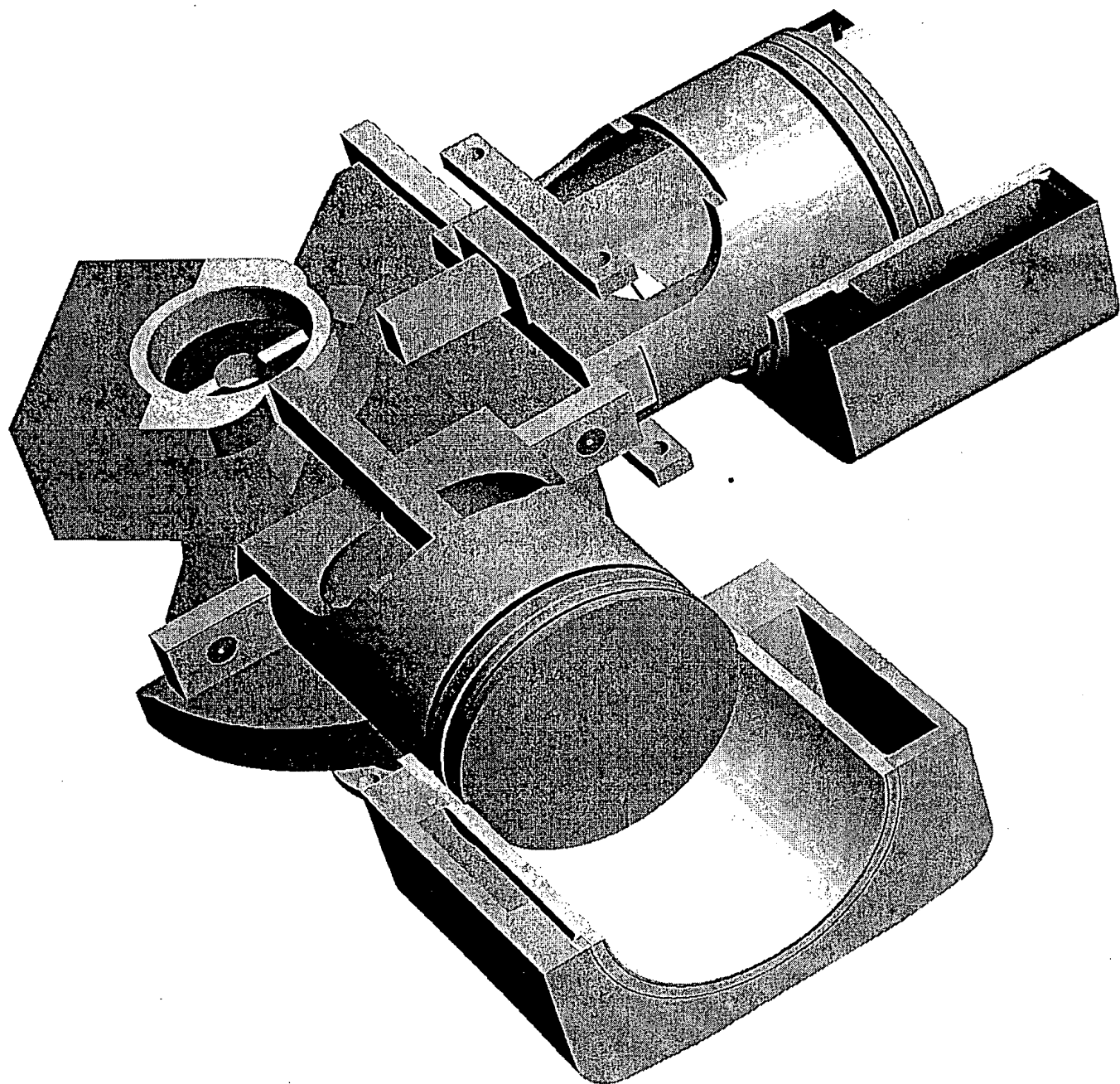


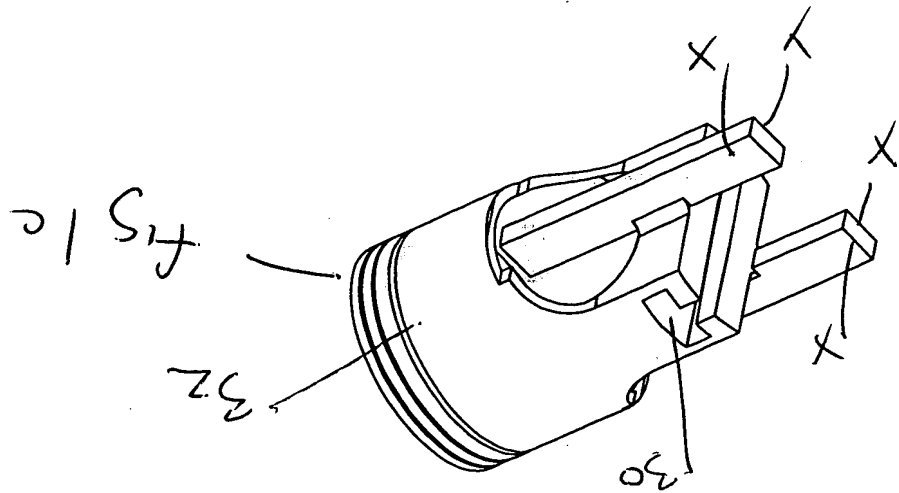
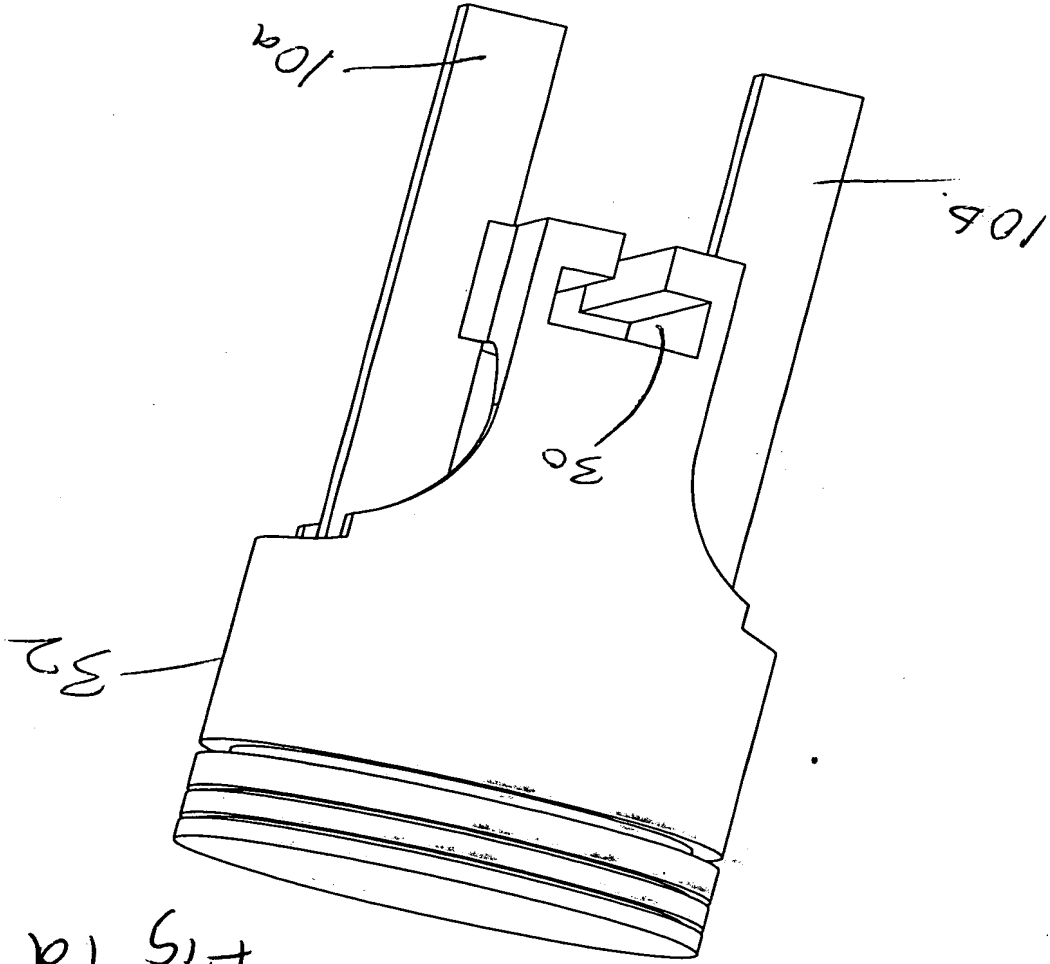












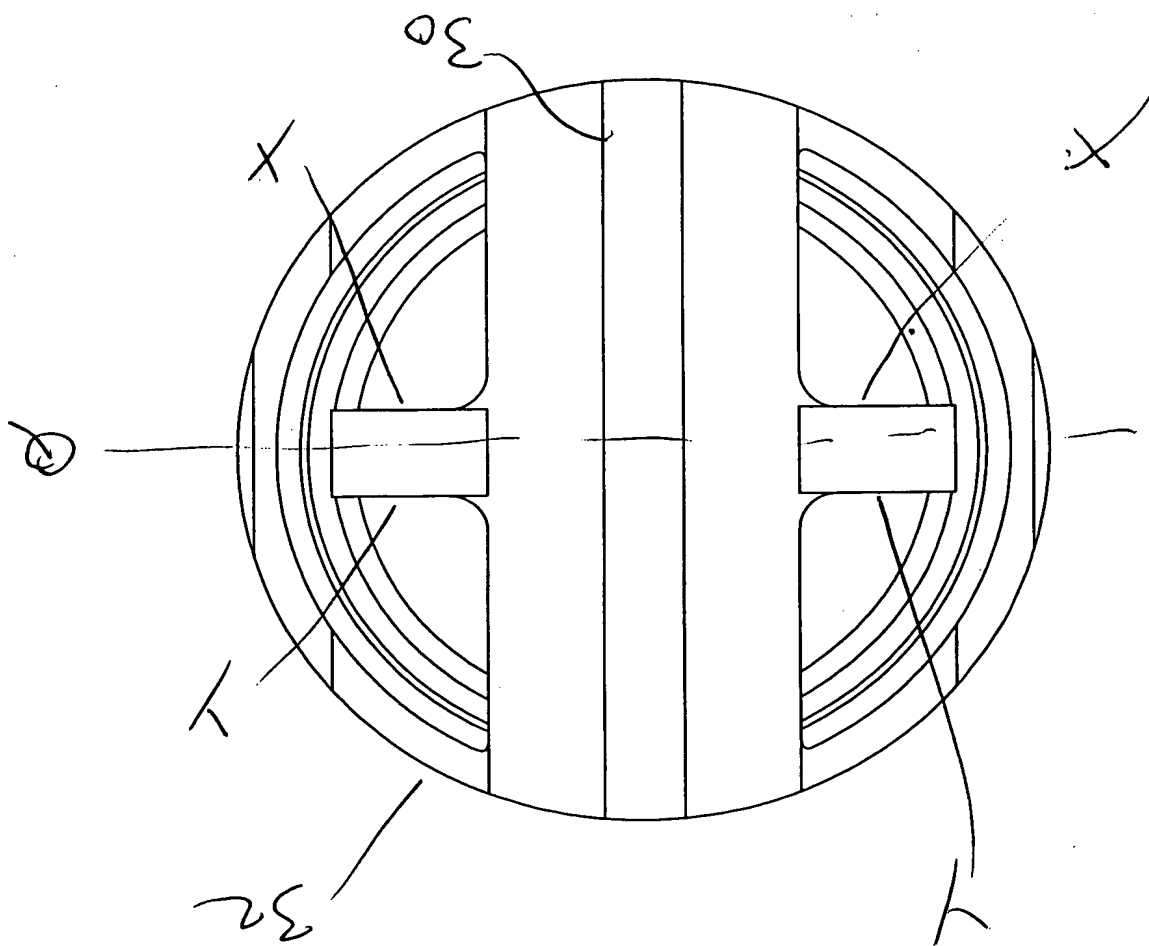
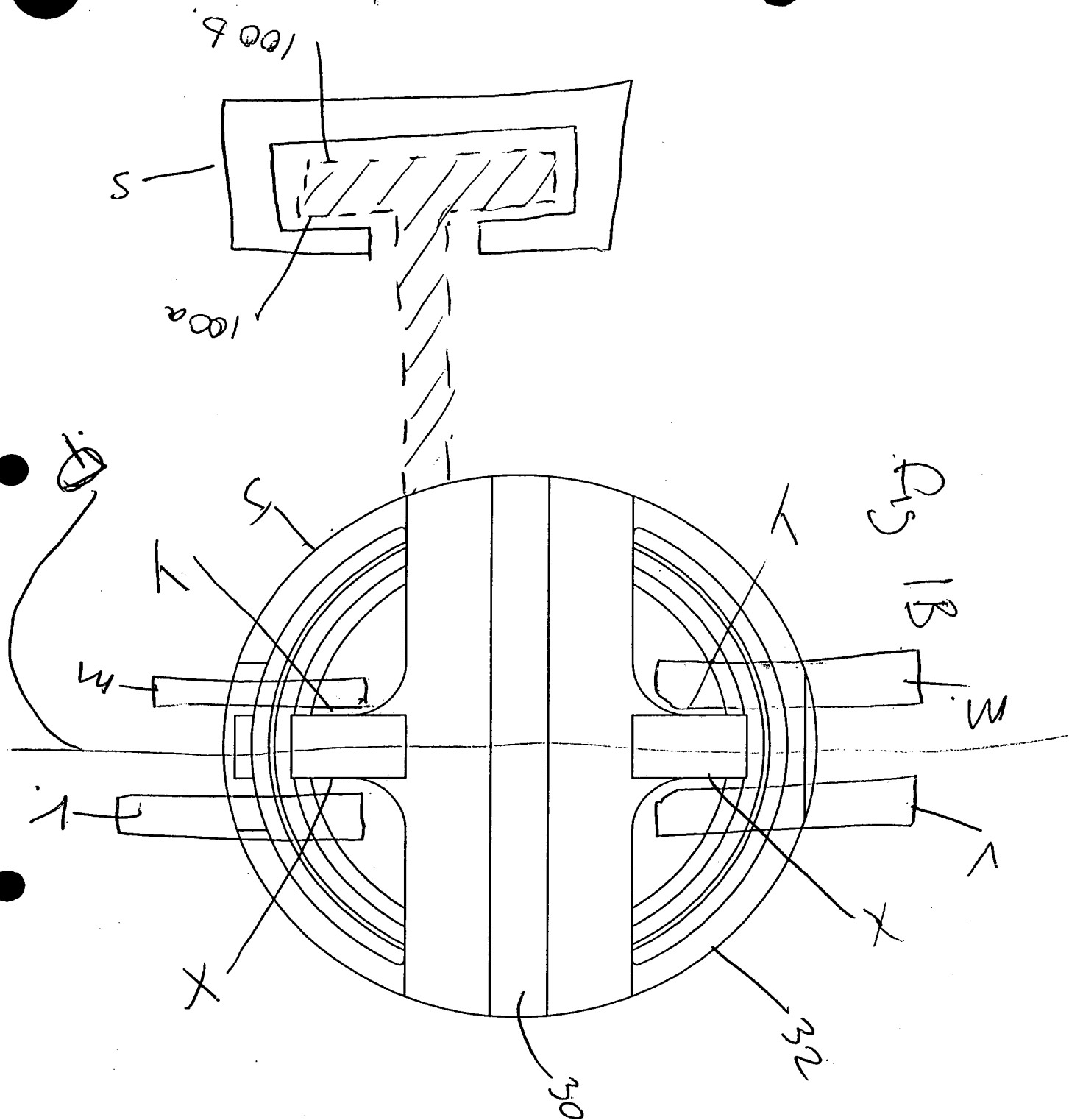
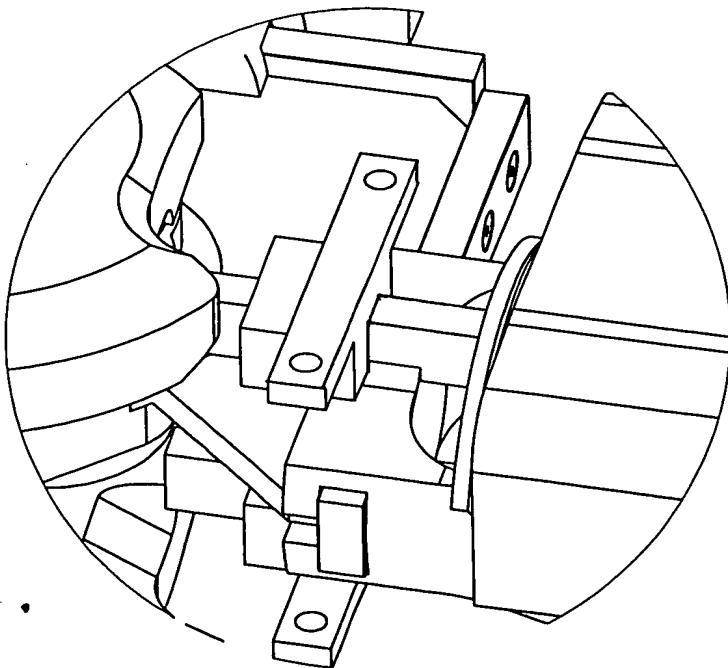
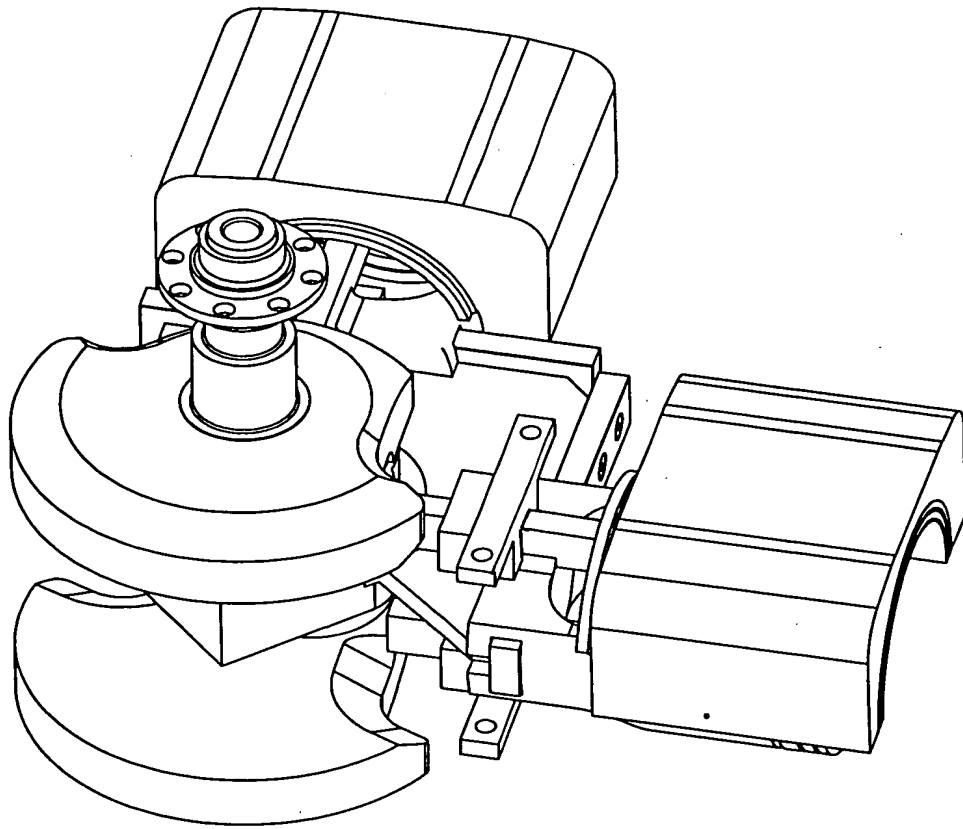


Fig 1a





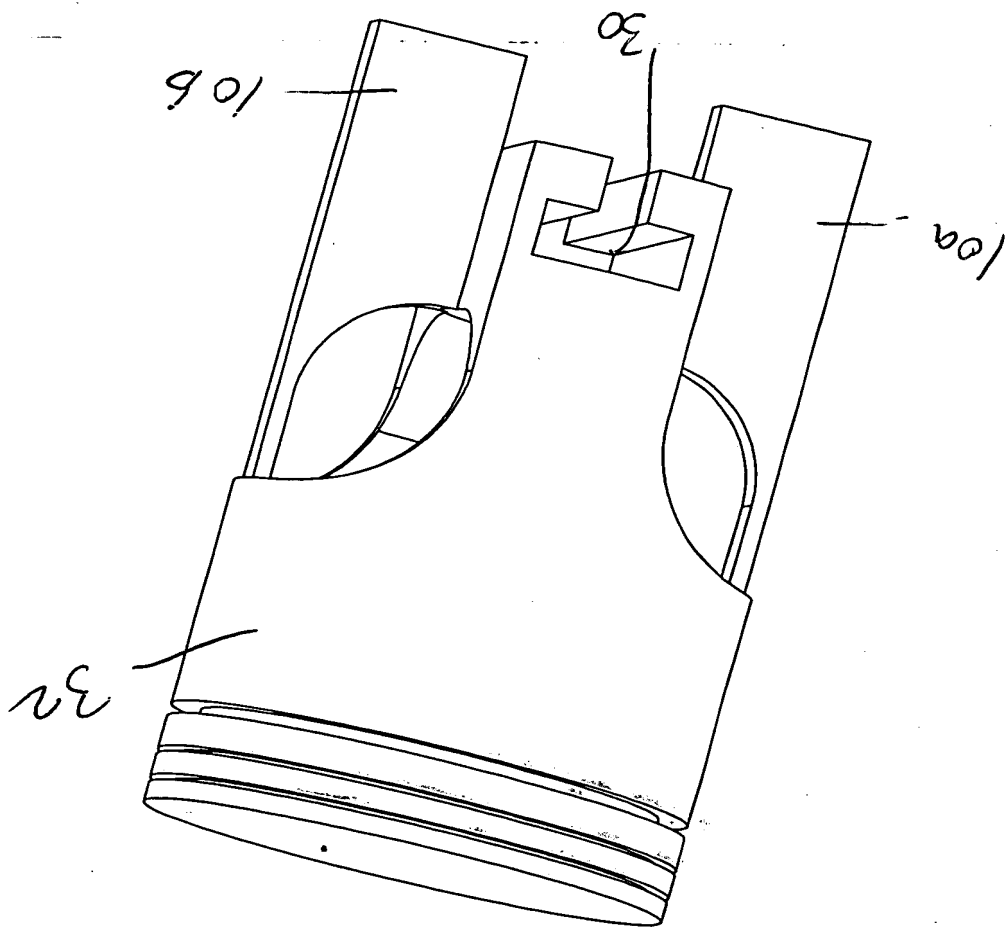


Fig 1A

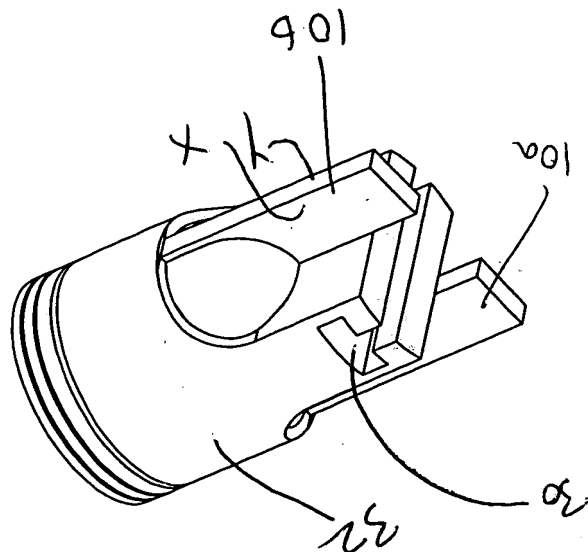


Fig 1B